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Takahashi

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(54) **LIQUID EJECTION APPARATUS AND INITIAL FILLING METHOD OF THE SAME**

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(51) **Int. Cl.**
B41J 2/175 (2006.01)

(52) **U.S. Cl.** **347/85**; 347/84; 347/86

(58) **Field of Classification Search** 347/84, 347/85, 86

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,585,358	B2 *	7/2003	Usui et al.	347/85
2004/0150695	A1 *	8/2004	Diaz-Felipe	347/85
2005/0285913	A1 *	12/2005	Yoshino et al.	347/85

FOREIGN PATENT DOCUMENTS

JP	2001-219574	8/2001
JP	2003-237100	8/2003

* cited by examiner

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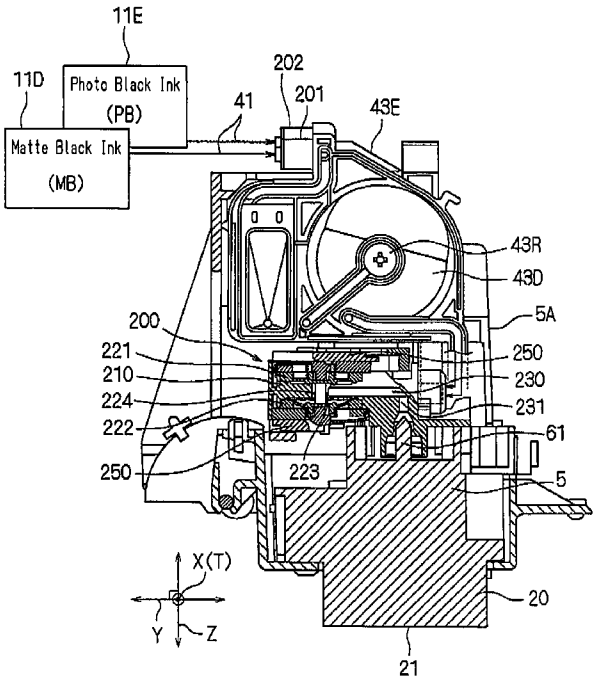
(57) **ABSTRACT**

A liquid ejection apparatus including an ejection head having a nozzle in which liquid is ejected through the nozzle, a plurality of cartridges that retain the liquid and supplies the liquid to the ejection head, and a switching mechanism that switches liquid to be supplied to the ejection head from a plurality of types of liquid supplied from the cartridges. The switching mechanism includes a body having a communication passage in communication with the ejection head, a first diaphragm chamber and a second diaphragm chamber that communicate with each other through the communication passage and located to facing each other, a first diaphragm and a second diaphragm arranged in the first diaphragm chamber and the second diaphragm chamber, respectively, and capable of opening and closing the communication passage, and an operation mechanism provided in the communication passage. The operation mechanism includes a first operation end and a second operation end that operate the first diaphragm and the second diaphragm, respectively, when the communication passage is opened to allow communication between at least one of the first and second diaphragm chambers and the ejection head, and an urging member that urges the first and second operation ends in a direction in which the communication passage is opened by the first and second diaphragms.

15 Claims, 13 Drawing Sheets



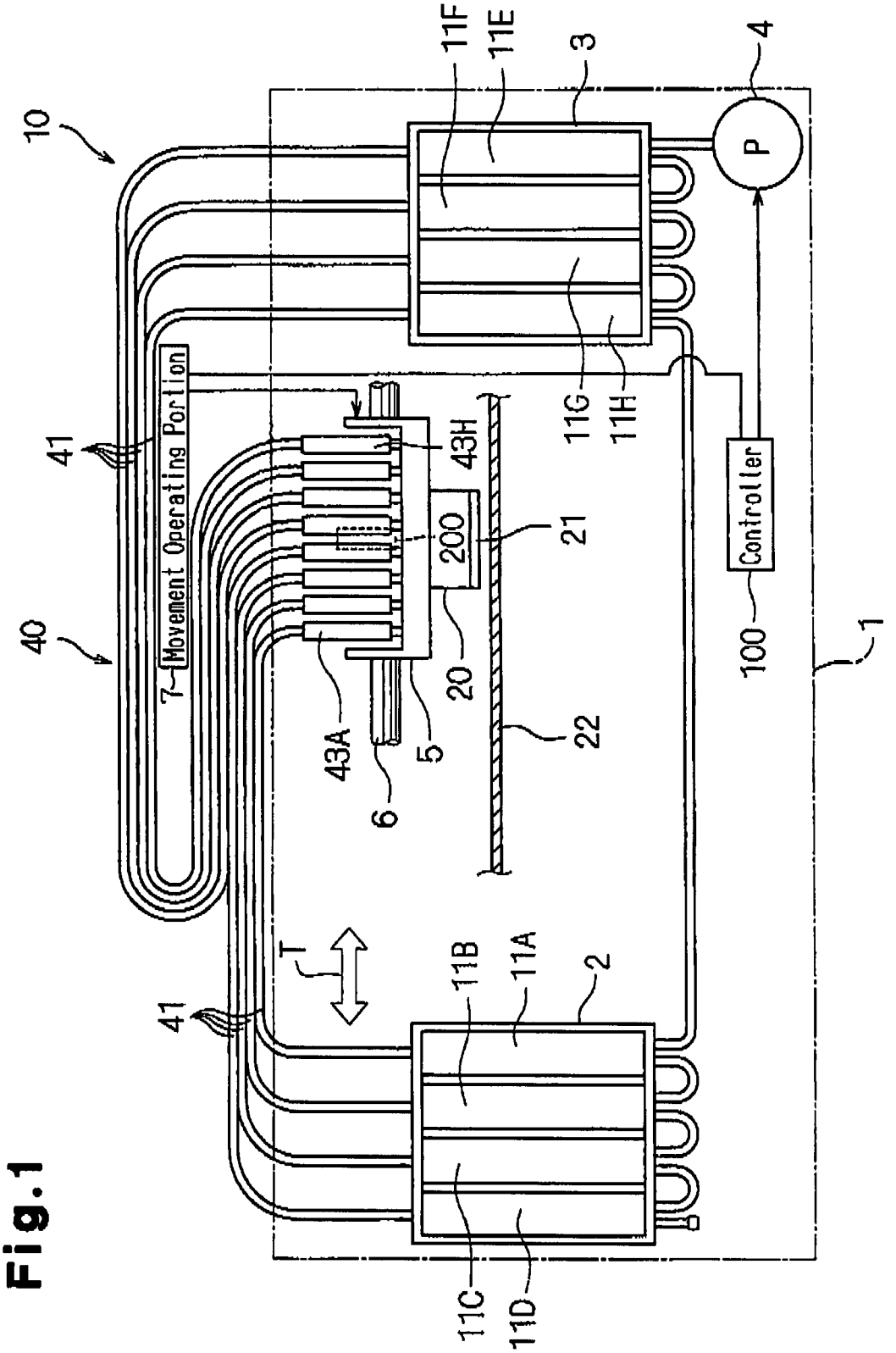

10
11F
11E
3
4
P
41
Movement Operating Portion
43H
11G
11H
Controller
200
21
40
7
20
100
1
43A
5
22
6
T
11B
11A
2
41
11C
11D

Fig.1

Fig.2

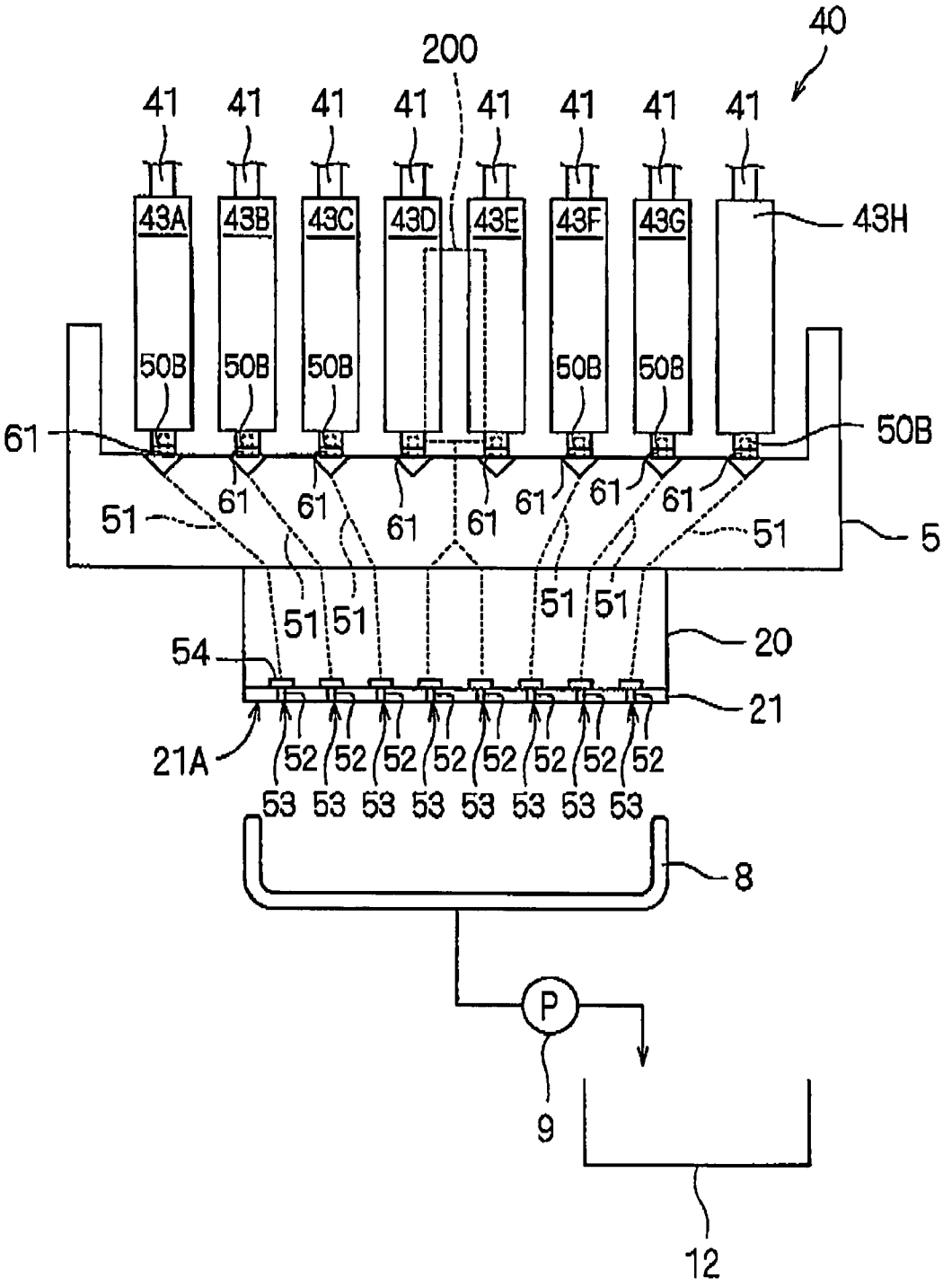

40
200
41
43A
43B
43C
43D
43E
43F
43G
43H
50B
61
51
5
20
54
21
21A
52
53
8
P
9
12

Fig.3

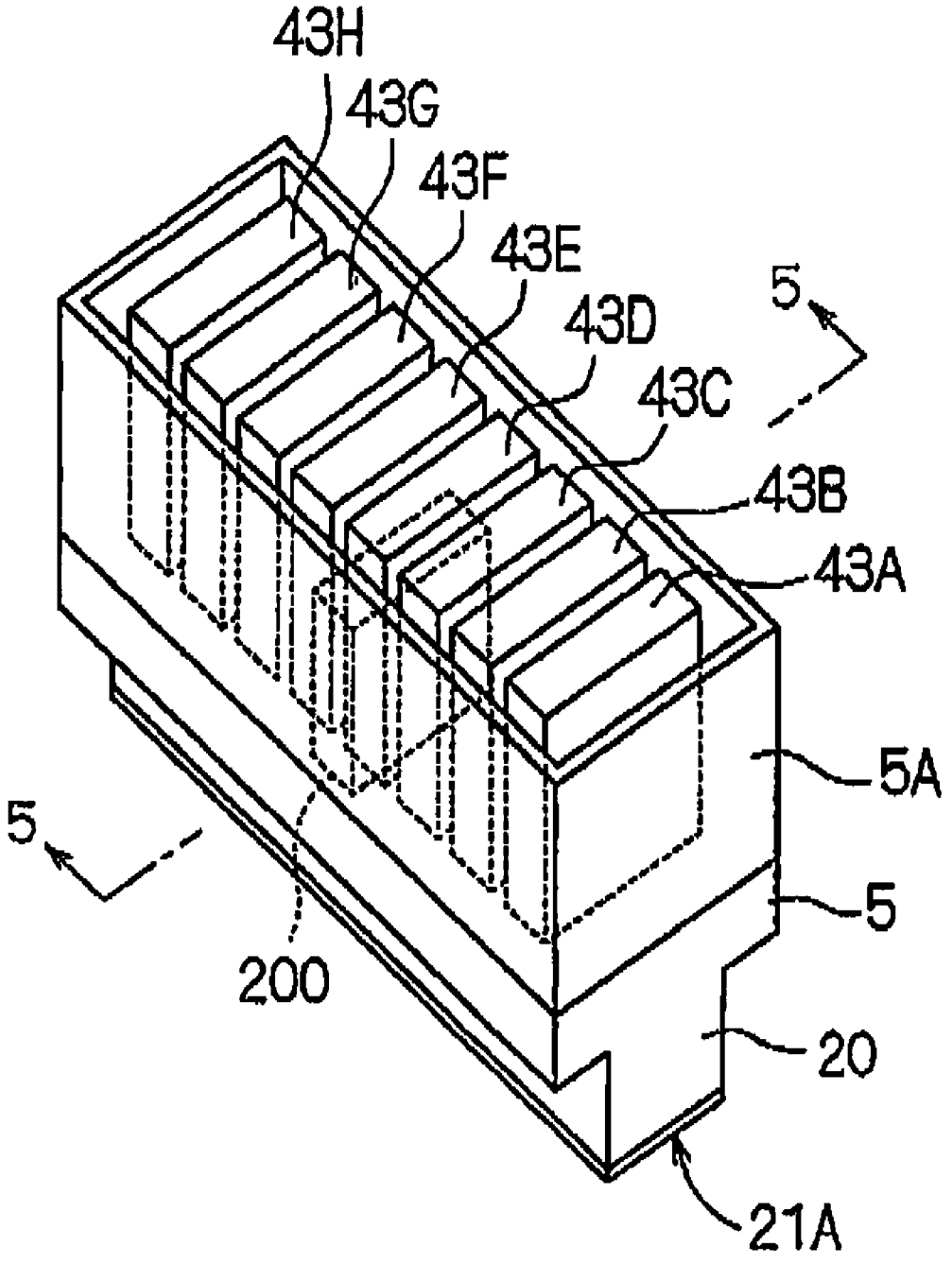


Fig.4

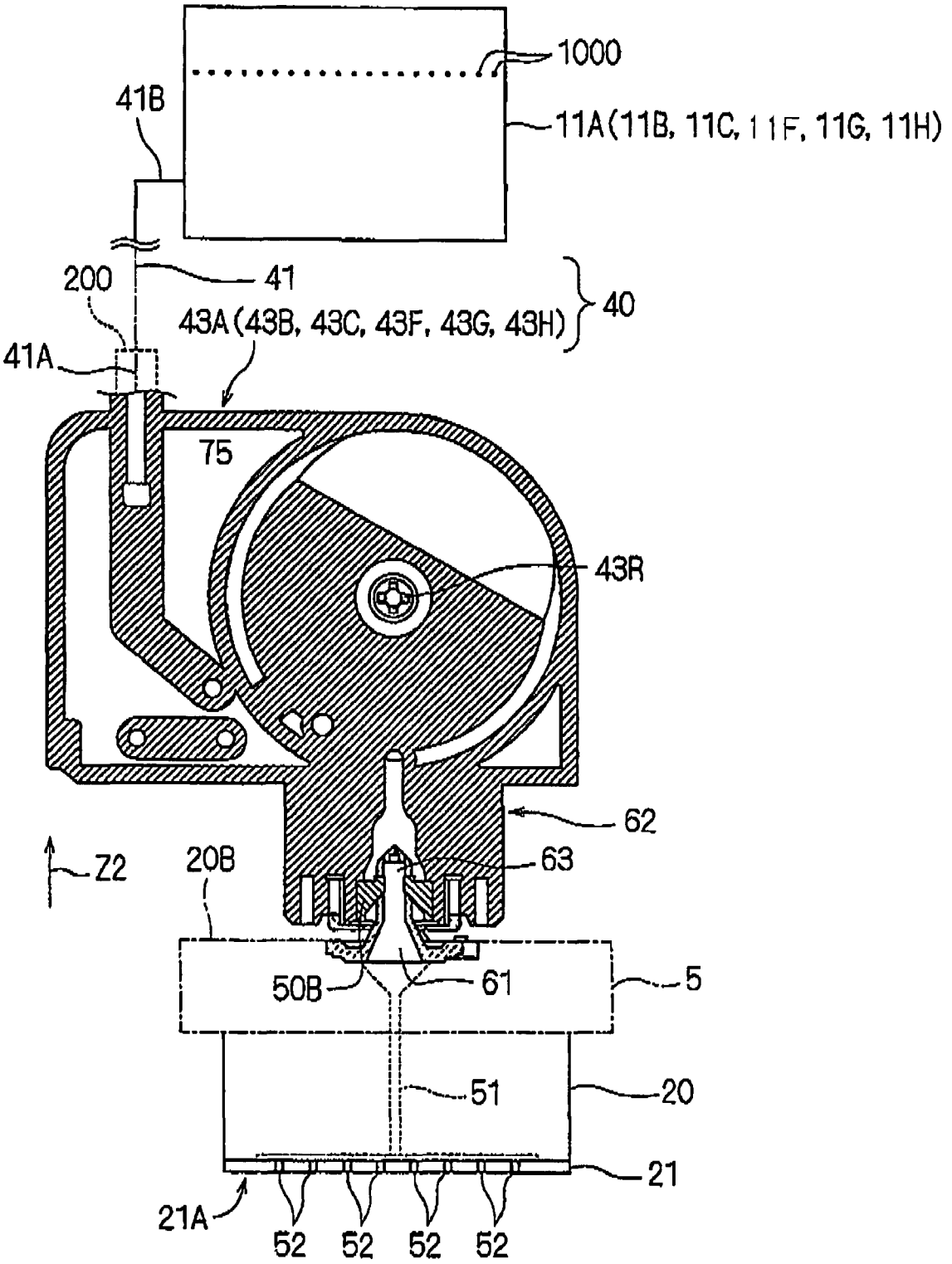

1000
41B
11A(11B, 11C, 11F, 11G, 11H)
200
41
40
43A(43B, 43C, 43F, 43G, 43H)
41A
75
43R
62
Z2
20B
63
50B
61
5
51
20
21
21A
52
52
52
52

Fig.5

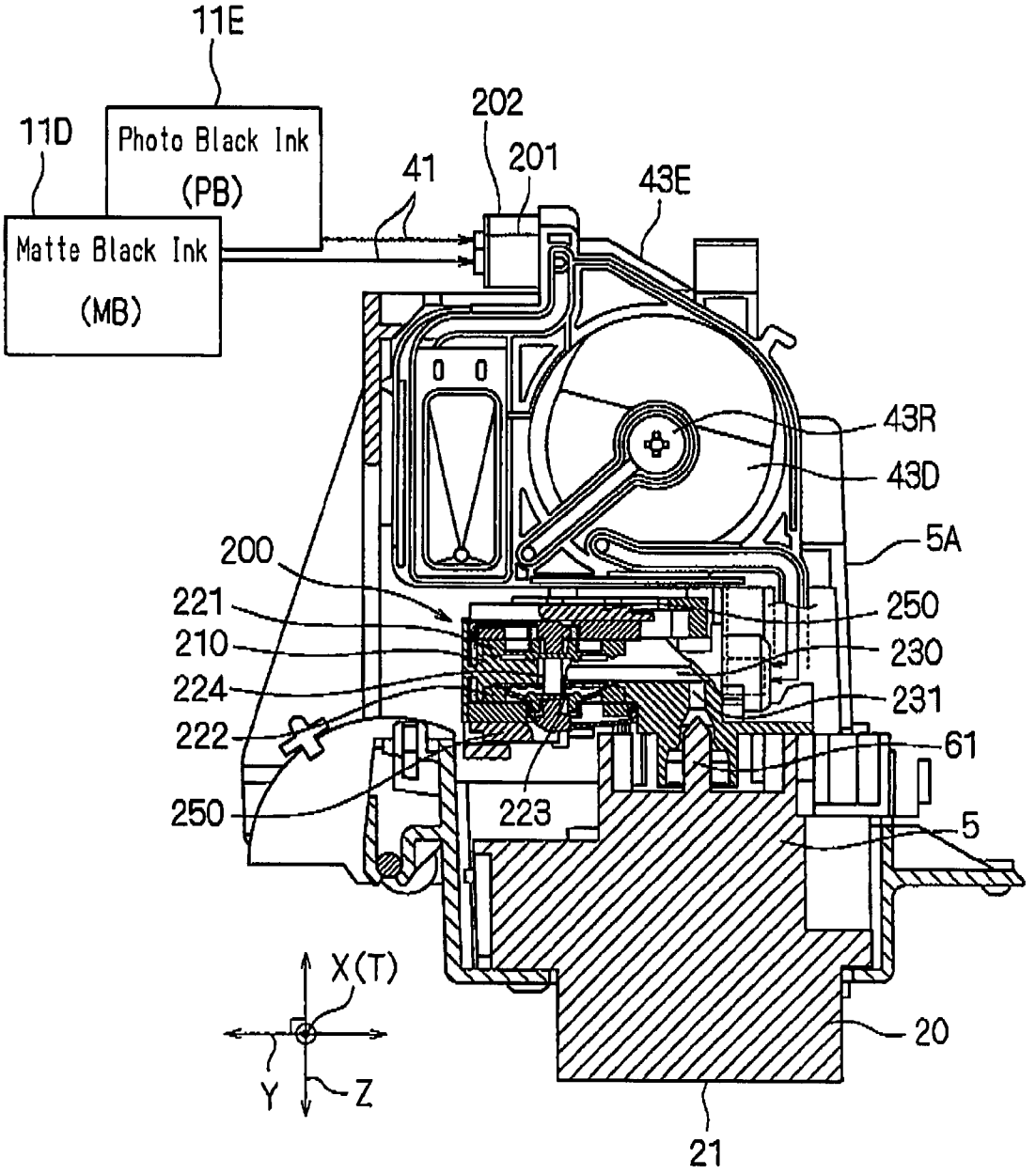

11E
11D
Photo Black Ink
(PB)
Matte Black Ink
(MB)
202
201
41
43E
43R
43D
5A
200
221
210
224
222
250
230
231
61
223
5
X(T)
Y
Z
20
21

Fig.6

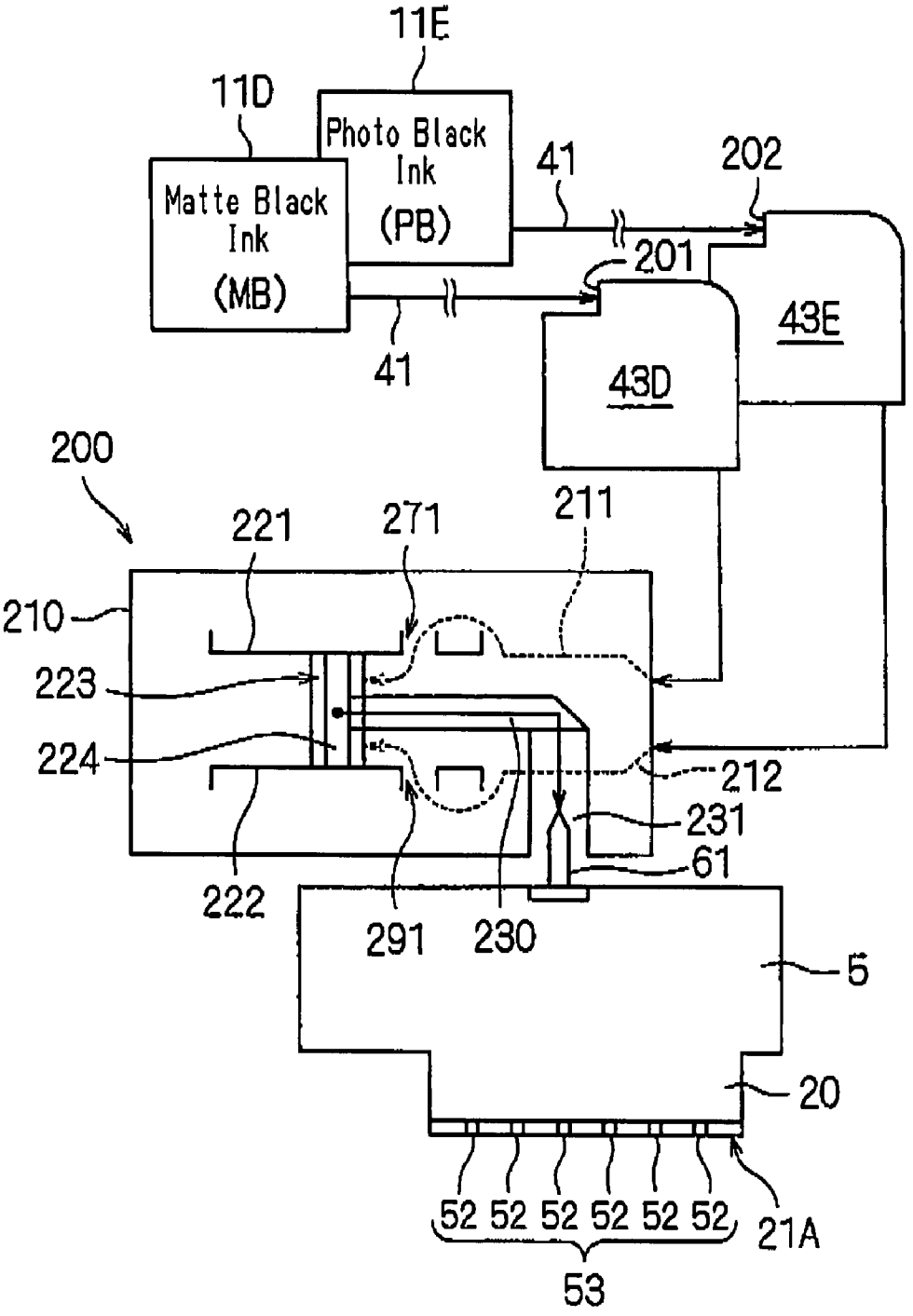

11E
11D
Photo Black Ink (PB)
Matte Black Ink (MB)
41
202
201
43E
43D
41
200
211
221
271
210
223
224
212
231
61
222
291
230
5
20
52 52 52 52 52 52
21A
53

Fig.7

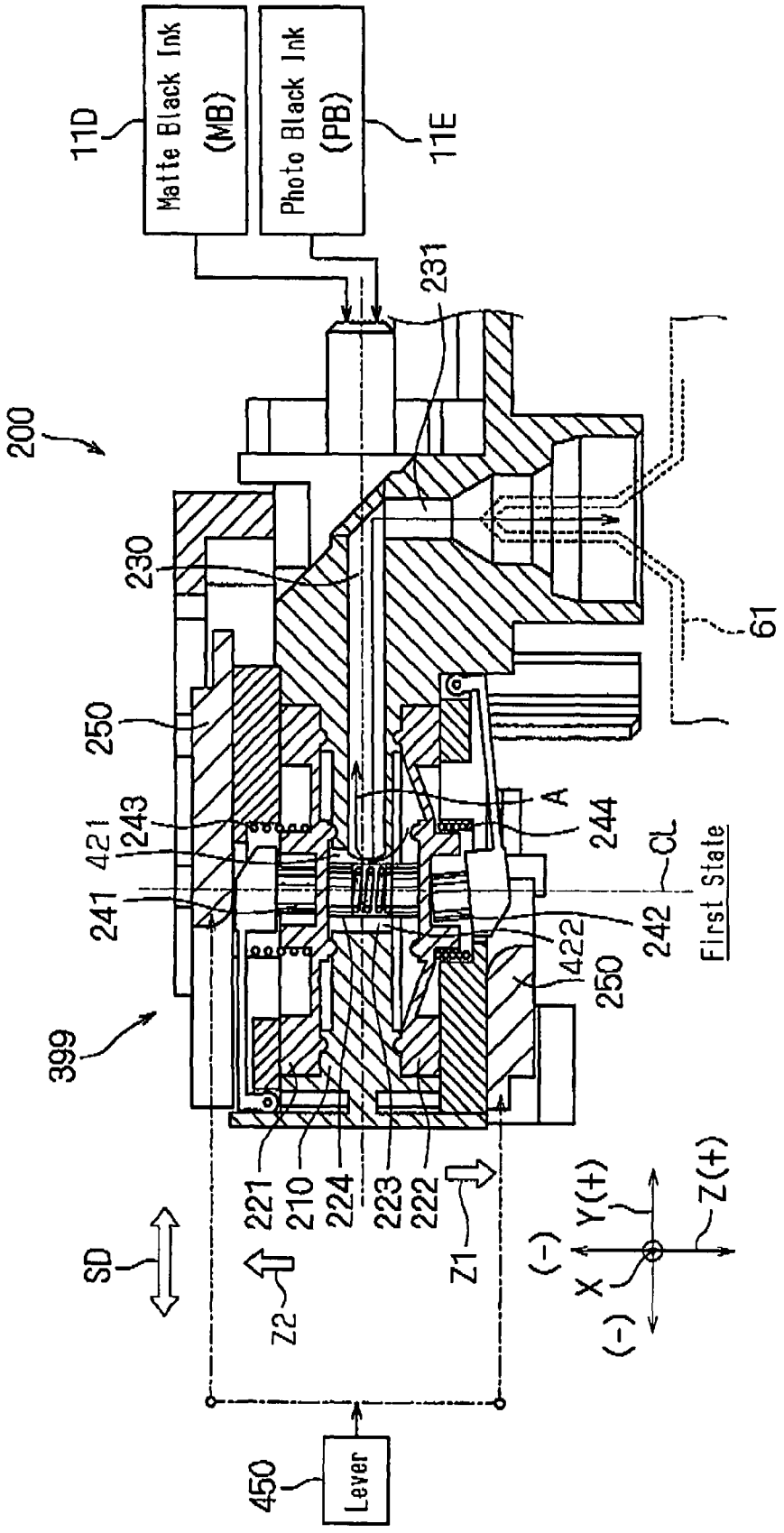

11D
Matte Black Ink (MB)
Photo Black Ink (PB)
11E
231
200
230
61
250
A
244
243
421
241
CL
First State
242
422
250
399
221
210
224
223
222
Z1
SD
Z2
Y(+)
Z(+)
(-)
X
(-)
450
Lever

Fig.8A

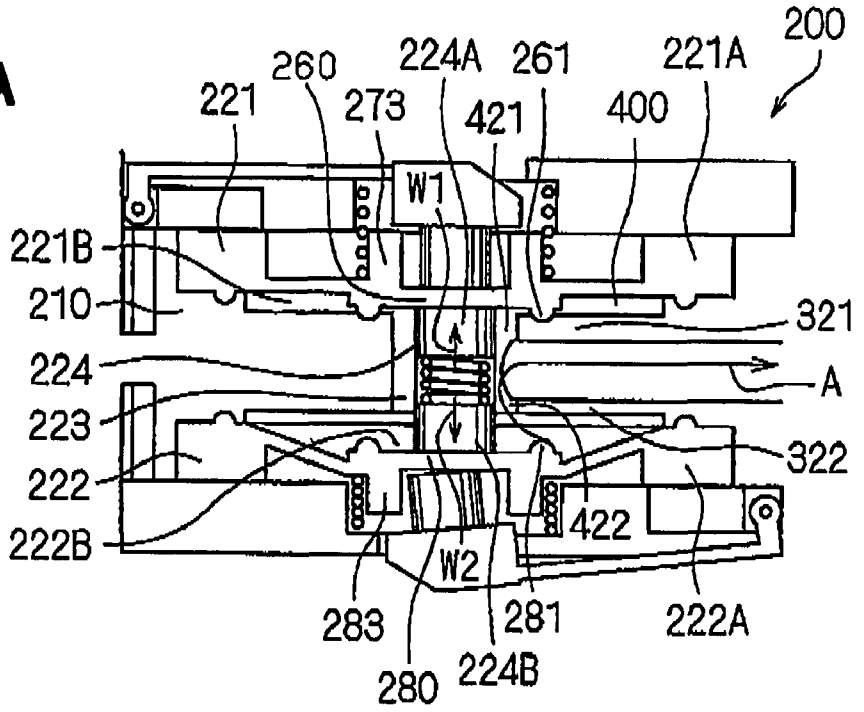

200
221
260
273
224A
261
421
400
221A
W1
221B
210
321
224
A
223
322
222
422
222B
W2
283
281
222A
280
224B

Fig.8B

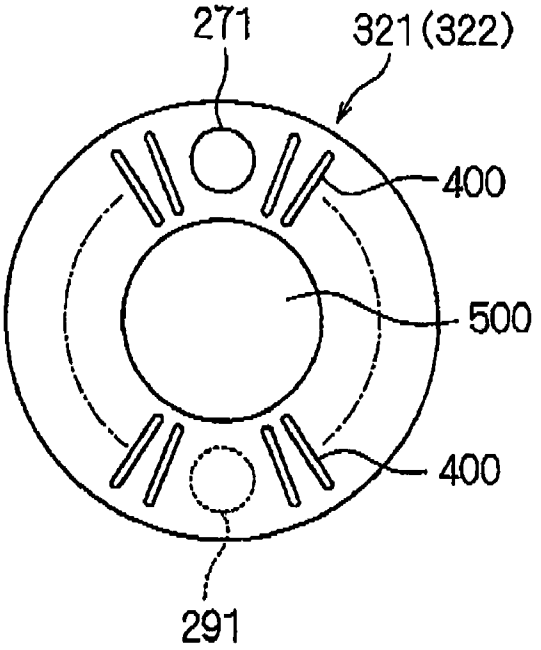
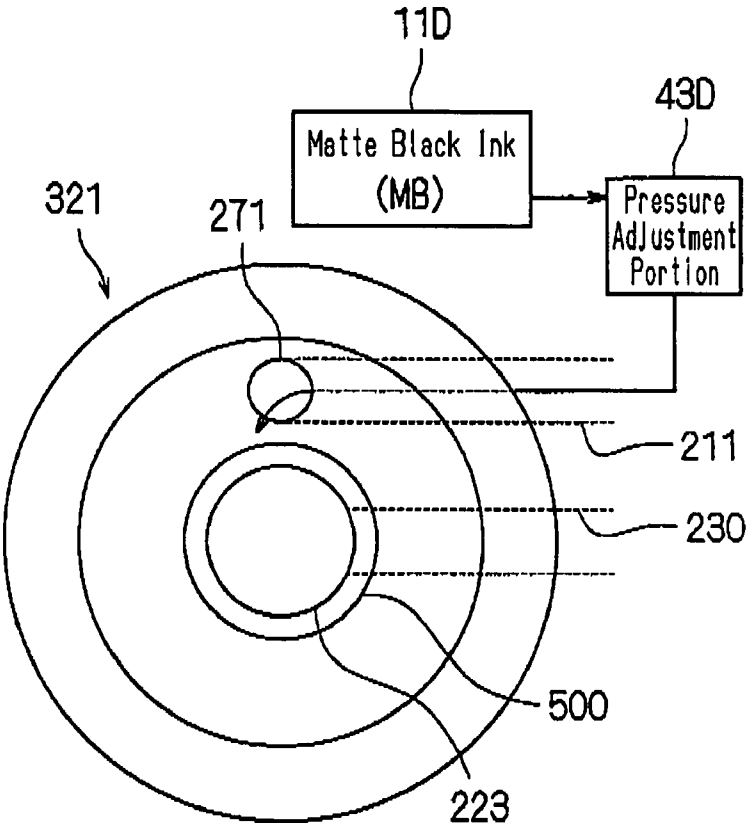
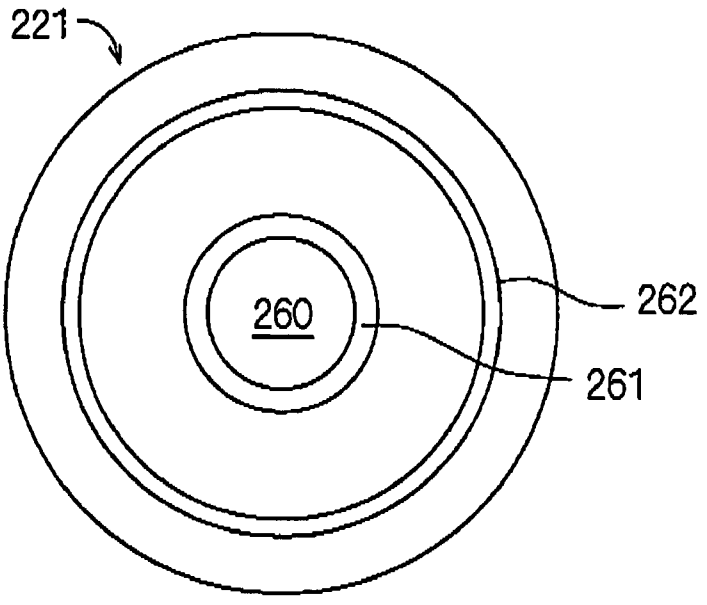

271
321(322)
400
500
400
291

Fig.9A



As Viewed in Direction W2

Fig.9B



As Viewed in Direction W1

Fig.10A

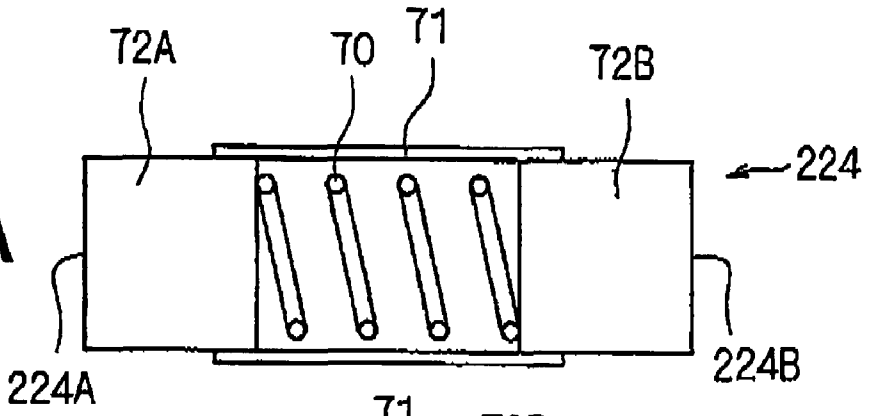


Fig.10B

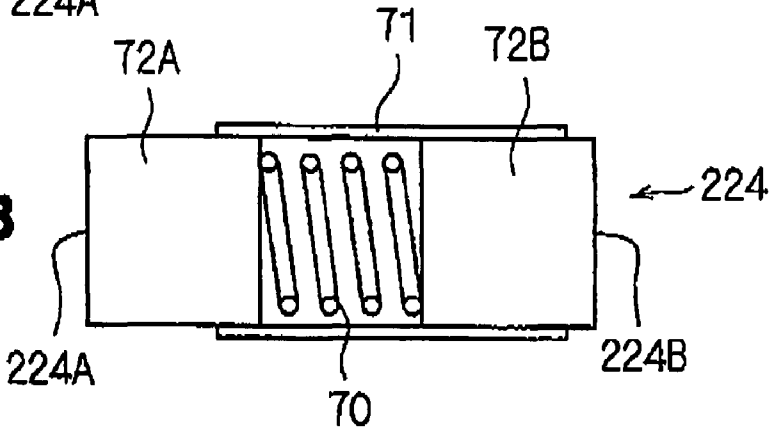


Fig.11

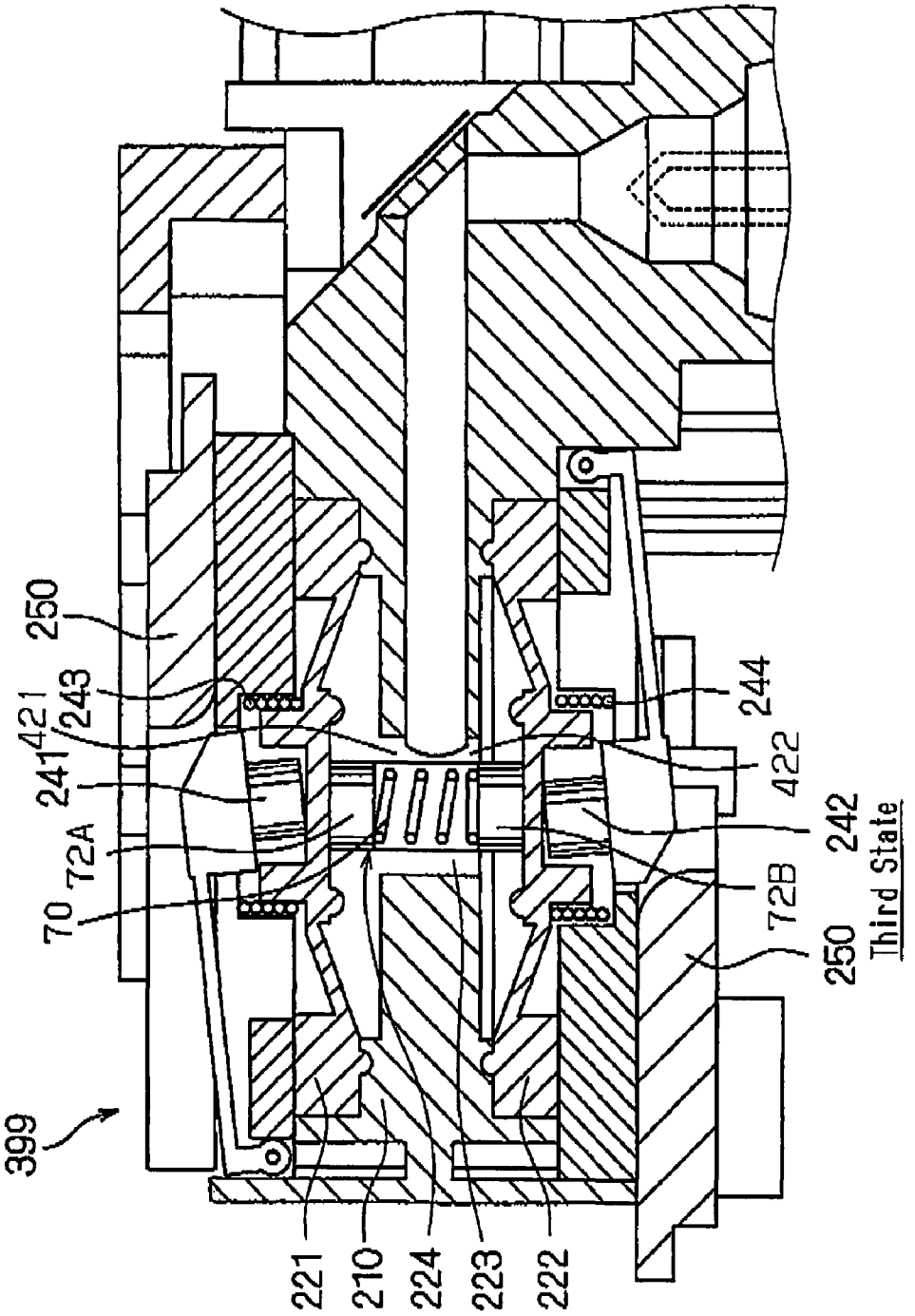

250
421
243
241
72A
70
399
221
210
224
223
222
244
422
242
72B
250
Third State

Fig.12

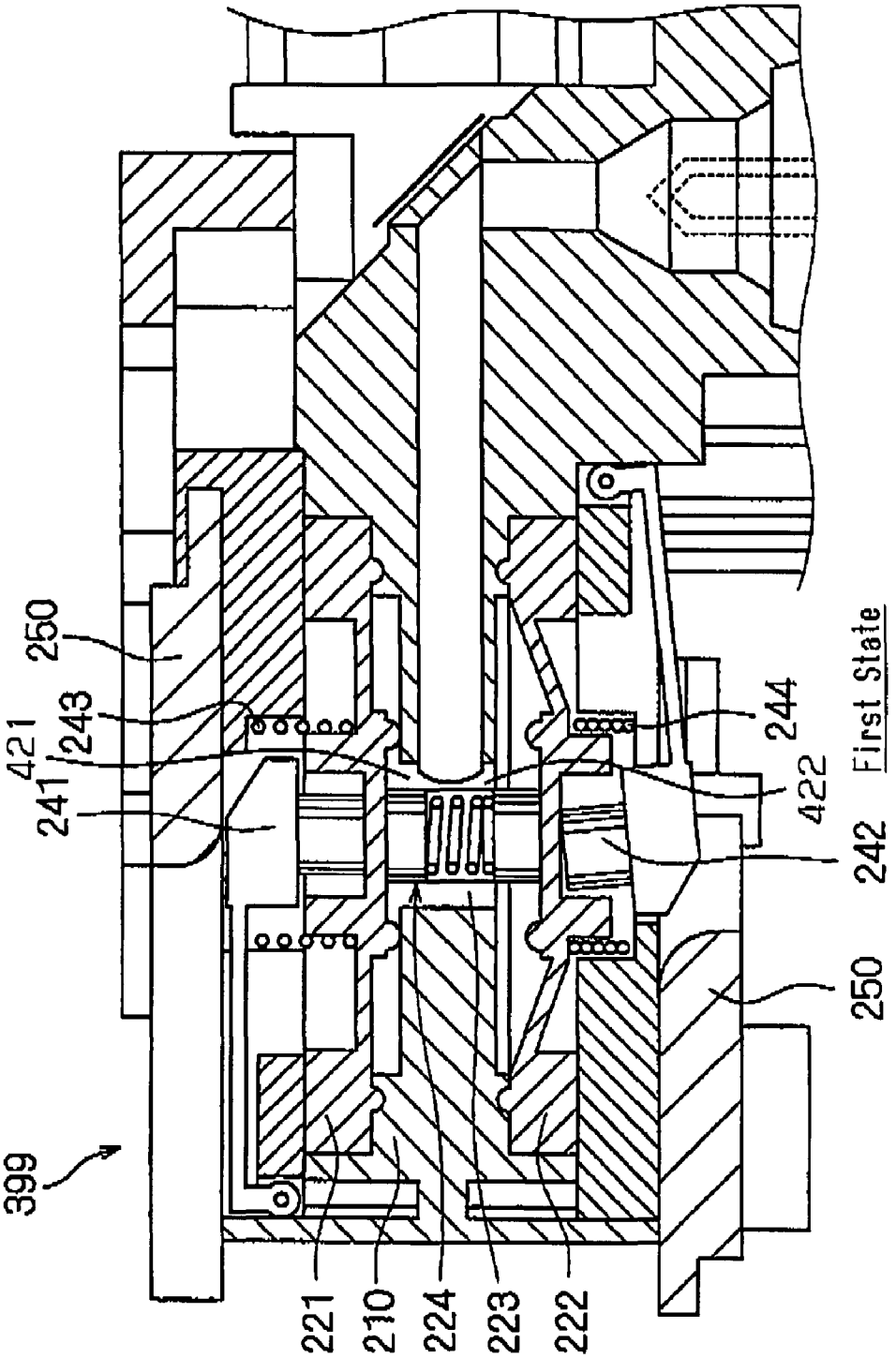
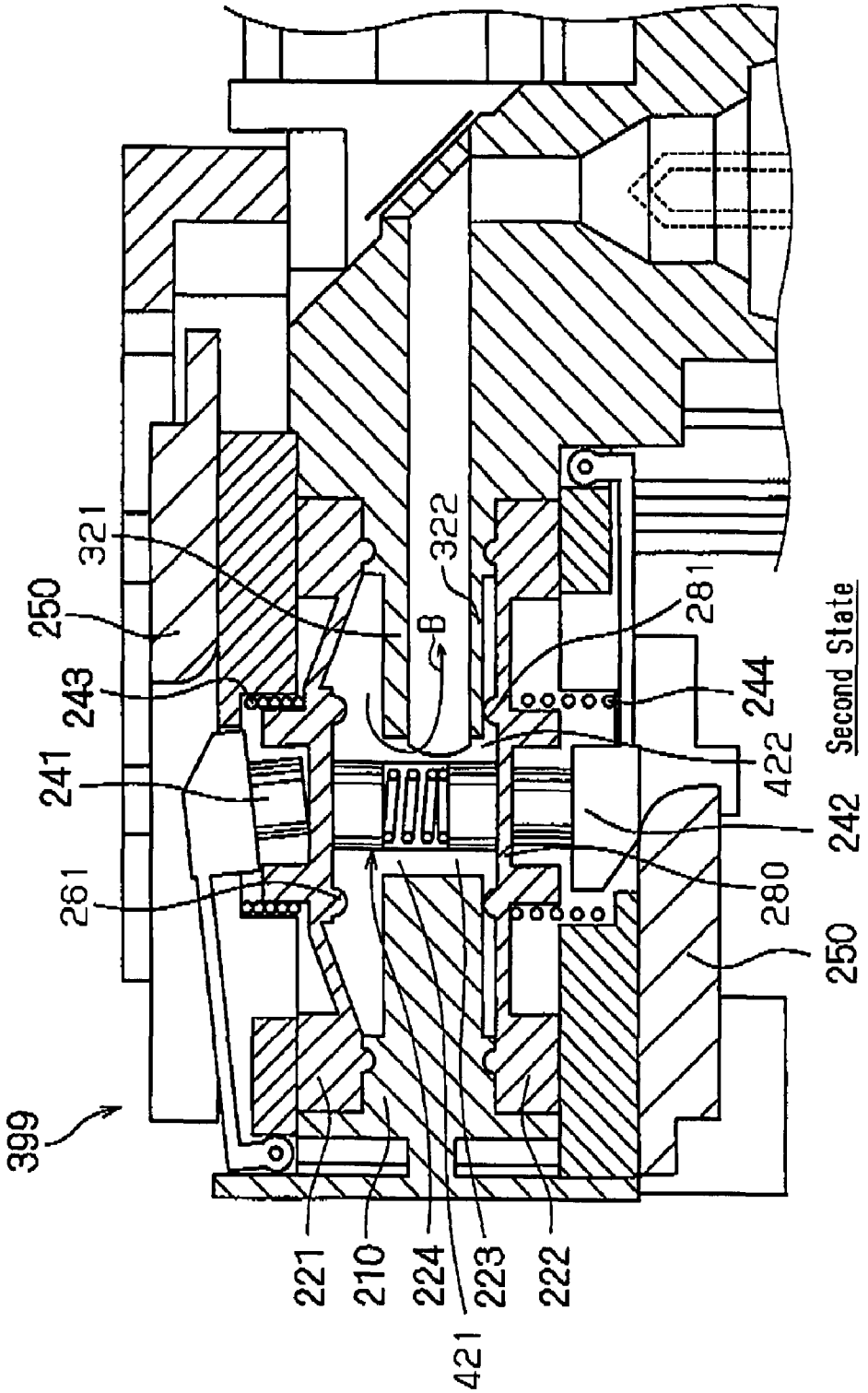

250
421
243
241
399
221
210
224
223
222
244
422
242
250
First State

Fig.13


321
322
250
B
281
243
244
241
422
Second State
242
261
280
250
399
221
210
224
223
222
421

LIQUID EJECTION APPARATUS AND INITIAL FILLING METHOD OF THE SAME

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is based upon and claims the benefit of priority from prior Japanese Patent Applications No. 2006-024151, filed on Feb. 1, 2006, and No. 2007-016785, filed on Jan. 26, 2007, the entire contents of which are incorporated herein by reference.

BACKGROUND

1. Technical Field

The present invention relates mainly to a liquid ejection apparatus used as an inkjet type recording apparatus that forms dots on a recording medium by ejecting ink droplets from nozzles in accordance with printing data and a method of initial filling of the liquid ejection apparatus.

2. Related Art

As a liquid ejection apparatus that ejects liquid onto a target, an inkjet type recording apparatus that performs printing by ejecting ink onto a recording paper sheet is known. This type of apparatus suppresses noise generated through printing to a relatively low level and is capable of forming small-sized dots at a high density. Therefore, an inkjet type recording apparatus is now frequently used for printing including color printing. Such apparatus includes an inkjet type printing head and a paper feeder mechanism. Ink is supplied from an ink cartridge to the printing head. The paper feeder mechanism transports a recording medium in a direction perpendicular to the scanning direction of the printing head.

The inkjet type recording apparatus performs recording by ejecting ink droplets onto the recording medium through mechanical pressure or thermal energy applied to the printing head while moving the printing head mounted in a carriage along the width of the recording medium (in the main scanning direction). Specifically, a printing head that ejects, for example, black ink and different color inks such as yellow, cyan, and magenta inks is mounted in the carriage of the inkjet type recording apparatus. The recording apparatus performs not only text printing using the black ink but also full-color printing by changing the ejecting proportion of the inks.

Further, to improve the quality of the color printing, a recording apparatus employing ink of a total of six colors, including black, has been developed. The six colors include light cyan, and light magenta as well as the aforementioned colors. Also, there is a demand for an inkjet type recording apparatus capable of performing large-scale printing on large-sized sheets of paper without replacing ink cartridges. In these cases, ink cartridges with increased capacities become necessary for supplying ink to the recording heads. To satisfy the demand, a recording apparatus configured as will be described in the following has been developed. Specifically, for example, ink cartridges are removably mounted not in a carriage but in cartridge holders arranged in securing portions formed at opposite side portions of the body of the apparatus. Ink is supplied from each of the cartridge holders to a printing head through, for example, a flexible tube and an ink supply passage.

This inkjet type recording apparatus can be applied to various types of printing through ejection of ink droplets from nozzle openings of the printing head. The ink cartridges are replaceable in accordance with the purposes for printing. In other words, if printing needs to be carried out with inks of different types than the inks retained in the currently mounted ink cartridges, the ink cartridges are temporarily separated from the apparatus and replaced by ink cartridges retaining desired types of ink. This structure leads to frequent demands for printings of different printing qualities using different types of inks in the same printer.

However, replacement of the ink cartridges is troublesome for the user of the recording apparatus. If an increased number of cartridges needs to be replaced, such troublesome user operation must be repeated a number of times. In a printing apparatus described in JP-A-2003-237100, the types of ink ejected from corresponding nozzle rows can be changed without replacing ink cartridges. Nonetheless, the apparatus does not allow such switching of the ink types in correspondence with the nozzle rows and is not applicable to a case in which the ink types must be switched in correspondence with the nozzle rows.

JP-A-2001-219574 describes a switch structure that allows switching of ink cartridges in correspondence with nozzle rows. However, the switch structure switches the ink cartridges, which are connected to the nozzle rows. Specifically, the number of ink cartridges that are simultaneously connected to each of the nozzle rows is always one. This makes it necessary to perform initial ink filling for each of the ink cartridges before the ink cartridges are initially used, which is disadvantageous. Further, in the recording apparatus having the above-described switch structure, there may be a case in which only one of the cartridges is used. In this case, bubbles may be generated in a corresponding ink passage, leading to a defect in ink ejection.

SUMMARY

Accordingly, it is an objective of the present invention to provide a liquid ejection apparatus and an initial filling method of the liquid ejection apparatus that allow simultaneous initial filling for multiple cartridges.

In accordance with one aspect of the present invention, a liquid ejection apparatus having an ejection head, a plurality of cartridges, and a switching mechanism is provided. The ejection head has a nozzle in which liquid is ejected through the nozzle. The cartridges retain the liquid and supply liquid to the ejection head. The switching mechanism switches liquid to be supplied to the ejection head from a plurality of types of liquids supplied from the cartridges. The switching mechanism includes a body, a first diaphragm chamber and a second diaphragm chamber, a first diaphragm and a second diaphragm, and an operation mechanism. The body has a communication passage in communication with the ejection head. The first and second diaphragm chambers communicate with each other through the communication passage and located facing each other. The first and second diaphragms are arranged in the first diaphragm chamber and the second diaphragm chamber, respectively. The first and second diaphragm are each capable of opening and closing the communication passage. The operation mechanism is provided in the communication passage. The operation mechanism includes a first operation end and a second operation end, and an urging member. The first and second operation ends operate the first diaphragm and the second diaphragm, respectively, when the communication passage is opened to allow communication between the ejection head and at least one of the first and second diaphragm chambers. The urging member urges the first and second operation ends in a direction in which the communication passage is opened by the first and second diaphragms.

In accordance with another aspect of the present invention, an initial filling method of the above mentioned liquid ejection apparatus is provided. According to this method, initial filing of the liquid is performed in a state in which the first and second operation ends are urged in the direction in which the communication passage is opened by the first and second diaphragms.

Other aspects and advantages of the invention will become apparent from the following description, taken in conjunction with the accompanying drawings, illustrating by way of example the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The features of the present invention that are believed to be novel are set forth with particularity in the appended claims. The invention, together with objects and advantages thereof, may best be understood by reference to the following description of the presently preferred embodiments together with the accompanying drawings in which:

FIG. **1** is a view showing an inkjet type recording apparatus according to an embodiment of the present invention;

FIG. **2** is an enlarged view showing a liquid supply passage portion, a carriage, and a recording head;

FIG. **3** is a perspective view showing an example of arrangement of the carriage, a pressure adjustment portion, and a liquid switching device;

FIG. **4** is a view showing ink cartridges, the liquid supply passage portion, and a recording head;

FIG. **5** is a cross-sectional view taken along line **5**-**5** of FIG. **3**;

FIG. **6** is a view showing an ink passage in two types of ink cartridges, two pressure adjustment portions, the liquid switching device, and the recording head;

FIG. **7** is a view showing a first state in which a first diaphragm closes a communication passage and a second diaphragm opens the communication passage;

FIG. **8**A is an enlarged view showing the vicinity of the communication passage;

FIG. **8**B is a view showing a first circumferential portion and a second circumferential portion;

FIG. **9**A is a view showing the first circumferential portion;

FIG. **9**B is a view showing the first diagram;

FIG. **10**A is a view showing an operation device;

FIG. **10**B is a view showing the operation device;

FIG. **11** is a view showing a third state, or an initial state, in which the first diaphragm and the second diaphragm open the communication passage;

FIG. **12** is a view showing a first state in which a first diaphragm closes a communication passage and a second diaphragm opens the communication passage; and

FIG. **13** is a view showing a second state in which the first diaphragm opens the communication passage and the second diaphragm closes the communication passage.

DESCRIPTION OF EXEMPLARY EMBODIMENTS

An embodiment of the present invention will now be described with reference to the attached drawings. FIG. **1** shows an inkjet type recording apparatus **10**, or a liquid ejection apparatus of the present invention. The inkjet type recording apparatus **10** is referred to as an inkjet printer. The inkjet type recording apparatus **10** has a body **1**. The body **1** has two cartridge holders **2**, **3**, a pressure pump **4**, a carriage **5**, a recording head **20**, a guide shaft **6**, a movement operating portion **7**, a liquid supply passage portion **40**, and a controller **100**.

A cartridge holder **2** and a cartridge holder **3** accommodate a plurality of ink cartridges **11**A to **11**H as cartridges. As shown in FIG. **1**, each of the cartridge holders **2**, **3** of the illustrated embodiment receives four ink cartridges. A total of eight ink cartridges **11**A to **11**H are mounted in the body **1**. The ink cartridges **11**A to **11**H retain, for example, cyan, magenta, yellow, matte black, photo black, light cyan, light magenta, and gray ink, respectively.

In the illustrated embodiment, the ink cartridge **11**D retains matte black ink (MB) and the ink cartridge **11**E retains photo black ink (PB). The ink cartridges **11**A to **11**H are accommodated in the cartridge holders **2**, **3** instead of being mounted directly in the carriage **5**. That is, the inkjet type recording apparatus **10** is an off-carriage type inkjet printer.

The pressure pump **4** applies pressure to the ink cartridges **11**A to **11**H by supplying compressed air to the cartridge holders **2**, **3**. This supplies the ink from the ink cartridges **11**A to **11**H to the recording head **20** of the carriage **5** through the liquid supply passage portion **40**.

The guide shaft **6** extends horizontally with respect to the body **1**. Through operation of the movement operating portion **7**, the carriage **5** is reciprocated on the guide shaft **6** along the main scanning direction T of the carriage **5** and thus positioned. The movement operating portion **7** has, for example, a non-illustrated motor and a non-illustrated synchronous belt driven by the motor. The synchronous belt is secured to the carriage **5** and the carriage **5**, together with the synchronous belt, moves in the main scanning direction T. The recording head **20** is provided in a lower portion of the carriage **5**. A nozzle plate **21** is fixed to the lower surface of the recording head **20**.

A recording paper sheet **22**, or an ejection target, is a type of recording medium. Characters and images can be recorded on the recording paper sheet **22** by the ink ejected from the recording head **20**. The recording paper sheet **22** can be transported by a non-illustrated paper sheet transport mechanism, for example, in a direction perpendicular to the main scanning direction T. The recording head **20** is an example of an ejection head that ejects liquid through nozzles and may be referred to as a printing head.

The liquid supply passage portion **40** is an ink supply path by which the ink is supplied from the ink cartridges **11**A to **11**H to the recording head **20**. The liquid supply passage portion **40** has tubes **41** and pressure adjustment portions **43**A to **43**H located between the corresponding ink cartridges **11**A to **11**H and the recording head **20**. Referring to FIG. **1**, in the illustrated embodiment, eight liquid supply passage portions **40** are provided in parallel between eight ink cartridges **11**A to **11**H and the carriage **5** and the recording head **20**.

FIG. **2** is an enlarged view showing the tubes **41** and the pressure adjustment portions **43**A to **43**H of the liquid supply passage portion **40**, the carriage **5**, and the recording head **20**. The pressure adjustment portions **43**A to **43**H are a unit for adjusting the pressure of the ink when the ink is supplied from the ink cartridges **11**A to **11**H, each of which is a liquid retainer, to the recording head **20**. A seal member **50**B is arranged below each of the pressure adjustment portions **43**A to **43**H.

The carriage **5** and the recording head **20** have ink passages **51**. The ink passages **51** connect the pressure adjustment portions **43**A to **43**H to a plurality of nozzle openings **52**, or nozzles of the recording head **20**. As viewed in FIG. **2**, the nozzle openings **52** are aligned along a direction perpendicular to the sheet surface of FIG. **2**. Each of the nozzle opening

rows **53**, or nozzle rows, is configured by a plurality of nozzle openings **52**. The nozzle opening rows **53** are arranged parallel with each other along, for example, the direction perpendicular to the sheet surface of FIG. **2**. The nozzle openings **52** are formed in a nozzle plate surface **21**A of the nozzle plate **21**. The nozzle openings **52** axe connected to a pressure chamber **54**. The ink cartridges **11**A to **11**H retain liquid and supply the liquid to the recording head **20**. The inks of the different colors are examples of the liquid.

FIG. **4** shows the six ink cartridges **11**A, **11**B, **11**C, **11**F, **11**G, **11**H, the liquid supply passage portion **40**, a needle member **61**, and the recording head **20**. In FIG. **4**, each of the ink cartridges **11**A, **11**B, **11**C, **11**F, **11**G, **11**H retains ink **1000**. The ink **1000** flows from the ink cartridges **11**A, **11**B, **11**C, **11**F, **11**G, **11**H to the seal materials **50**B through the flexible tubes **41** and the passage defined in the pressure adjustment portions **43**A, **43**B, **43**C, **43**F, **43**G, **43**H. A self-sealing valve (a depressurization valve) **43**R is received in each of the pressure adjustment portions **43**A, **43**B, **43**C, **43**F, **43**G, **43**H. The self-sealing valves **43**R operate to decrease and adjust the pressure of the ink **1000** that is sent from the ink cartridges **11**A, **11**B, **11**C, **11**F, **11**G, **11**H to the recording head **20** through the tubes **41** and the needle members **61**.

When the carriage **5** accelerates or decelerates and the pressure of the ink **1000** in the tubes **41** varies, ejection of ink droplets becomes unstable. In this state, the pressure adjustment portions **43**A, **43**B, **43**C, **43**F, **43**G, **43**H suppresses such pressure variation of the ink **1000**. An ink passage **63** is defined in a projecting portion **62** of each of the pressure adjustment portions **43**A to **43**H. The seal member **50**B can be removably fitted in the lower end of each of the ink passages **63**.

Each of the needle members **61** projects from an upper portion **20**B of the recording head **20** in a second direction Z**2** in FIG. **4**, or toward the pressure adjustment portions **43**A to **43**H. The needle members **61** are each passed through the ink passage **63**, as shown in FIG. **4**. This structure supplies the ink **1000** from the ink cartridges **11**A, **11**B, **11**C, **11**F, **11**G, **11**H to the recording head **20** through the tubes **41**, the pressure adjustment portions **43**A, **435**, **43**C, **43**F, **43**G, **43**H, and the ink passages **63**.

As shown in FIGS. **1** to **3**, a switching device **200** is mounted in the vicinity of the recording head **20**, or, preferably, in the carriage **5**. FIG. **3** shows the switching device **200**, the pressure adjustment portions **43**A to **43**H, the carriage **5**, and the recording head **20**. The carriage **5** has a holder **5**A. The holder **5**A is a holding portion that accommodates the pressure adjustment portions **43**A to **43**H. The switching device **200** functions as a switching mechanism that switches liquid supplied to an ejection head from a plurality of types of liquid provided from a plurality of cartridges. In the illustrated embodiment, the switching device **200** is mounted in the holder **5**A.

Referring to FIG. **2**, a cap member **8**, or a sealing member, a suction pump **9**, and a waste liquid tank **12** are provided in a non-printing area defined on the movement path of the carriage **5**. The cap member **8** is formed of flexible material, which is, for example, rubber. When the carriage **5** is located in the non-printing area, a nozzle plate surface **21**A of the recording head **20** is sealed by the cap member **8**. That is, the cap member **8** functions as a lid body that prevents dryness of the nozzle openings **52** of the recording head **20** when the body **1** is in a non-operating period.

The bottom surface of the cap member **8** is connected to the suction pump **9** through a tube. The space in the cap member **8** is subjected to suction by the suction pump **9** in such a manner that the negative pressure produced by the suction pump **9** acts on the recording head **20**. In this manner, the ink is drained from the recording head **20**. The cap member **8** in a printing area includes a wiping member (not shown), which is formed of elastic material such as rubber. This allows the cap member **8** to wipe and clean the nozzle plate surface **21**A of the recording head **20** when necessary.

FIG. **5** shows the structure along the cross section taken along line **5**-**5** of FIG. **3**. The pressure adjustment portions **43**D, **43**E are received in the holder **5**A. As shown in FIGS. **1** and **3**, the switching device **200** is arranged between, for example, the pressure adjustment portions **43**D, **43**E and above the carriage **5**. In FIG. **5**, direction Z extending in the up-and-down direction of the drawing, direction Y extending in the left-and-right direction of the drawing, and direction X extending perpendicular to the sheet surface of the drawing are defined as illustrated. Direction X extends in the same direction as the main scanning direction T in FIG. **1**. The ink cartridge **11**D retains the matte black ink MB and is connected to a connecting portion **201** of the pressure adjustment portion **43**D through the corresponding tube **41**. The ink cartridge **11**E retains the photo black ink PB and is connected to a connecting portion **202** of the pressure adjustment portion **43**E through the corresponding tube **41**.

FIG. **6** shows connection paths extending from the ink cartridges **11**D, **11**E, which are shown in FIG. **5**, to the two pressure adjustment portions **43**D, **43**E, the switching device **200**, and the recording head **20** schematically for facilitating understanding. The pressure adjustment portion **43**D is connected to a first diaphragm chamber of a first diaphragm **221** through a first passage portion **211** of a body **210** of the switching device **200**. The pressure adjustment portion **43**E is connected to a second diaphragm chamber of a second diaphragm **222** through a second passage portion **212** of the body **210**. The first passage portion **211** is connected to a communication passage **223** through an ink inlet hole **271** of the first diaphragm **221**. The second passage portion **212** is connected to the communication passage **223** through an ink inlet hole **291** of the second diaphragm **222**.

The body **210** includes a line **230** and a line **231**. The communication passage **223**, together with the line **230** and the line **231**, defines an ink passage and communicates with the recording head **20**. The corresponding one of the needle members **61** is inserted into the line **231**. The needle member **61** and the structure of the interior of the recording head **20** are shown in FIG. **4**.

The first diaphragm **221** and the second diaphragm **222** of the switching device **200** selectively open and close the communication passage **223**. This switches between the passage of the matte black ink MB of the ink cartridge **11**D and the passage of the photo black ink PB of the ink cartridge **11**E. This supplies one of the matte black ink MB or the photo black ink PB to the recording head **20** through the corresponding one of the needle members **61**. The ink is then ejected from the nozzle openings **52** of the nozzle opening row **53**.

FIG. **7** shows, in detail, the configuration of the switching device **200** shown in FIGS. **5** and **6**. FIG. **7** illustrates a first state in which the first diaphragm **221** closes one of a pair of openings of the communication passage **223** and the second diaphragm **222** opens the other opening. In a second state, contrastingly to the first state of FIG. **7**, the second diaphragm **222** closes one of the openings of the communication passage **223** and the first diaphragm **221** opens the other opening. The first state and the second state will be described in detail later.

The configuration of the switching device **200** as the switching mechanism will hereafter be explained with reference to FIG. **7**. The switching device **200** includes the body **210**, the first diaphragm **221**, the second diaphragm **222**, an

operation device **224** as an operation mechanism, a first pressing member **241**, a second pressing member **242**, first and second urging members **243**, **244**, and sliders **250**. The body **210** has the lines **230**, **231** and the communication passage **223**, which communicates with the recording head **20**. The needle members **61** are inserted into the lines **231**.

The first diaphragm **221** is shaped identically to the second diaphragm **222**. The first diaphragm **221** and the second diaphragm **222** are located at symmetrical positions in the up-and-down direction. FIG. **8**A is an enlarged view showing the vicinity of the first diaphragm **221** and the second diaphragm **222**, FIG. **9**A shows the shape of a first circumferential portion **321** of the body **210**, as viewed in direction W**2** in FIG. **8**A. FIG. **9**B shows the shape of the first diaphragm **221** as viewed in direction W**1** in FIG. **8**A.

In the body **210**, the first diaphragm **221** and the second diaphragm **222** communicate with each other through the communication passage **223** and are located in a first diaphragm chamber **221**B and a second diaphragm chamber **222**B, respectively. The first and second diaphragm chambers **221**B, **222**B are arranged to face each other. As shown in FIGS. **8**A and **9**B, the first diaphragm **221** has a thin disk-shaped film-like portion **260** and a first seal portion **261** held in tight contact with the first circumferential portion **321**. The first seal portion **261** is an annular projection and the film-like portion **260** is formed inside the first seal portion **261**.

With reference to FIG. **9**B, an annular projection **262** is provided outside the first seal portion **261** of the first diaphragm **221**. The first seal portion **261** selectively tightly contacts and separates from the first circumferential portion **321** of the body **210** by opening and closing the first diaphragm **221**. Contrastingly, the projection **262** is constantly held in tight contact with the first circumferential portion **321**. With reference to FIGS. **8**A, **8**B, and **9**B, the ink inlet hole **271** is defined in the first circumferential portion **321** of the body **210** and between the position corresponding to the first seal portion **261** and the position corresponding to the projection **262**. The ink inlet hole **271** introduces the ink from the pressure adjustment portion **43**D to the communication passage **223** through the first diaphragm chamber **221**B. Referring to FIG. **9**A, an area **500** sealed by the first seal portion **261** is defined around the communication passage **223** in the first circumferential portion **321**.

The second diaphragm **222** has a thin disk-shaped film-like portion **280** and a second seal portion **281** held in tight contact with a second circumferential portion **322**. The second seal portion **281** is an annular projection and the film-like portion **280** is formed inside the second seal-portion **281**. An annular projection is provided outside the second seal portion **281** of the second diaphragm **222**. Through the opening and closing operation, the second seal portion **281** is caused to selectively tightly contact and separate from the second circumferential portion **322** of the body **210**. Contrastingly, the projection is constantly held in tight contact with the second circumferential portion **322**. An area **500** sealed by the second seal portion **281** is provided around the communication passage **223** in the second circumferential portion **322**.

As indicated by the chain line in FIG. **8**B, an ink inlet hole **291** is defined in the second circumferential portion **322** of the body **210** and at the position facing the ink inlet hole **271** through the area **500**. The ink inlet hole **291** introduces the ink from the pressure adjustment portion **43**E to the communication passage **223** through the second diaphragm chamber **222**B.

The first diaphragm **221** and the second diaphragm **222** are formed of rubber material or plastic material or other types of material that are elastically deformable. As shown in FIG. **8**A, a base **221**A and a base **222**A, which extend outwardly, are formed at the outer end of the first diaphragm **221** and the outer end of the second diaphragm **222**, respectively. A projection **273** and a projection **283**, which extend outwardly, are formed at the position corresponding to the film-like portion **260** in the first diaphragm **221** and the position corresponding to the film-like portion **280** in the second diaphragm **222**, respectively.

The operation device **224** is provided in the communication passage **223** and opens the first diaphragm **221** and the second diaphragm **222**. In other words, the operation device **224** opens the communication passage **223** by operating the first diaphragm **221** and the second diaphragm **222**. A first operation end **224**A of the operation device **224** is arranged in the first diaphragm chamber **221**B and contacts the film-like portion **260**. A second operation end **224**B of the operation device **224** is arranged in the second diaphragm chamber **2225** and contacts the film-like portion **280**. Referring to FIG. **7**, the operation device **224** is arranged in the communication passage **223** to extend along the axis CL of the communication passage **223**, or along direction Z in FIG. **7**.

The first pressing member **241** presses the film-like portion **260** from outside in a first direction Z**1** as viewed in FIG. **7**. The second pressing member **242** presses the film-like portion **280** from outside in a second direction Z**2** as viewed in FIG. **7**. The first and second pressing members **241**, **242** are allowed to wobble at a small angle about the respective support points. As shown in FIGS. **7** and **8**A, a first urging member **243** is arranged around the first pressing member **241** and urges the film-like portion **260** in the first direction Z**1**. The first urging member **243** presses the first diaphragm **221** against the first circumferential portion **321**, which is located around an opening communicating with the first diaphragm chamber **221**B of the communication passage **223**, to seal the opening. A second urging member **244** is arranged around the second pressing member **242** and urges the film-like portion **280** in the second direction Z**2**. The second urging member **244** presses the second diaphragm **222** against the second circumferential portion **322**, which is located around an opening communicating with the second diaphragm chamber **222**B of the communication passage **223**, to seal the opening.

As illustrated in FIG. **8**B, a plurality of grooves **400** are defined in the surface of the first circumferential portion **321** and the surface of the second circumferential portion **322**, extending radially. The first circumferential portion **321** faces the first diaphragm **221** and tightly contacts the first diaphragm **221**. The second circumferential portion **322** faces the second diaphragm **222** and tightly contacts the second diaphragm **222**. The grooves **400** thus face the first diaphragm **221** or the second diaphragm **222**.

The grooves **400** are defined in the first circumferential portion **321** and the second circumferential portion **322** for the following reason. Specifically, as shown in FIGS. **7** and **8**A, when the surface of the first diaphragm **221** facing the first circumferential portion **321** is held in tight contact with the first circumferential portion **321**, the grooves **400** prevent the first diaphragm **221** from becoming fixed in tight contact with the first circumferential portion **321**. Similarly, when the surface of the second diaphragm **222** facing the second circumferential portion **322** is held in tight contact with the second circumferential portion **322**, the grooves **400** prevent the second diaphragm **222** from becoming fixed in tight contact with the second circumferential portion **322**. This allows the first diaphragm **221** and the second diaphragm **222** to smoothly and reliably open or close an opening **421** communicating with the first diaphragm chamber **221**B and an opening **422** communicating with the second diaphragm chamber

222B in the communication passage **223**. Alternatively, uneven portions may be formed in the surface of the first circumferential portion **321** and the surface of the second circumferential portion **322**, instead of the grooves **400** shown in FIG. **8**B.

The first pressing member **241**, the second pressing member **242**, and the sliders **250** form a switch operating portion **399** that operates the operation device **224** by pressing the first diaphragm **221** or the second diaphragm **222** to switch the open/closed state of each opening **421**, **422** of the communication passage **223**. In the switch operating portion **399**, the first pressing member **241** presses the first diaphragm **221** against the opening **421** of the communication passage **223** to seal the communication passage **223**. The second pressing member **242** presses the second diaphragm **222** against the opening **422** of the communication passage **223** to seal the communication passage **223**. The sliders **250** slide in a sliding direction that passes through the position at which the sliders **250** contact the first pressing member **241** or the second pressing member **242** and the position at which the sliders **250** separate from the first pressing member **241** or the second pressing member **242**. In this manner, the sliders **250** move the first pressing member **241** and the second pressing member **242** in the first direction Z**1** or the second direction Z**2**. The first direction Z**1** extends along the axis CL of the communication passage **223**. The second direction Z**2** extends along the axis CL of the communication passage **223** and in the direction opposite to the first direction Z**1**.

The sliders **250** are provided in the respective ones of the first pressing member **241** and the second pressing member **242**. By manipulating a lever **450** connected to each of the sliders **250**, the slider **250** is allowed to linearly reciprocate in a sliding direction SD shown in FIG. **7**.

In the first state shown in FIG. **7**, the slider **250** corresponding to the first pressing member **241** presses the first pressing member **241** in the first direction Z**1** in FIG. **7**. Contrastingly, in the second state, the slider **250** corresponding to the second pressing member **242** moves in direction Y(+) along the sliding direction SD in FIG. **7**. This raises the second diaphragm **222** in direction Z**2** in FIG. **7**, instead of the first diaphragm **221**. In this manner, through reciprocation of the levers **450** in the sliding direction SD, the opening **421** and the opening **422** of the communication passage **223** are alternately opened and closed through the first pressing member **241**, the second pressing member **242**, the first diaphragm **221**, and the second diaphragm **222**.

The first direction Z**1** and the second direction Z**2** along which the first pressing member **241** and the second pressing member **242** are moved through operation of the corresponding sliders **250** extend along the direction in which the communication passage **223** is opened by the first diaphragm **221** and the second diaphragm **222**. The sliding direction SD of the sliders **250** extends substantially perpendicular to the first direction Z**1** and the second direction Z**2** of the first pressing member **241** and the second pressing member **242**.

The levers **450** are preferably provided above the carriage **5**, which is shown in FIG. **3**. The levers **450** are manually operable by, for example, the operator. However, the present invention is not restricted to this. That is, sliding of the sliders **250** may be electrically brought about by, for example, an electromagnetic solenoid.

FIGS. **10**A and **10**B show the operation device **224**. The operation device **224** has a pillar-like first operating portion **72**A, a pillar-like second operating portion **723**, and an urging member **70** arranged between the first and second operating portions **72**A, **72**B. One end of a cylindrical cover member **71**, which covers the urging member **70**, is secured to the first operating portion **72**A. The second operating portion **72**B is slidably received in the other end of the cover member **71** with the urging member **70** inserted in the cover member **71**.

When the operation device **224** is compressed from the left and right as viewed in FIG. **10**A, the second operating portion **72**B slides in the cover member **71** and compresses the urging member **70**, referring to FIG. **10**B. In this state, a first operation end **224**A that opens the opening **421** of the communication passage **223** against the force of the first diaphragm **221** and a second operation end **224**B that opens the opening **422** of the communication passage **223** against the force of the second diaphragm **222** are urged in the opening direction of the first diaphragm **221** and the opening direction of the second diaphragm **222**, or toward the first diaphragm **221** and the second diaphragm **222**, respectively. The urging force of the urging member **70** of the operation device **224** is set to a value that is greater than the urging force of the first urging member **243** secured to the first diaphragm **221** and than the urging force of the second urging member **244** secured to the second diaphragm **222**.

When the switching device **200** switches from one color of ink to another, the open/closed states of the opening **421** and the opening **422** of the communication passage **223** are switched through operation of the sliders **250**. Further, the nozzle plate surface **21**A of the recording head **20** is capped by the cap member **8** and the ink, which has been used, is drawn and drained from the nozzle openings **52** by the suction pump **9**. This supplies unused ink from the ink cartridges to the recording head **20**, thus replacing the ink in the recording head **20** and the passages.

Next, switching of ink by the switching device **200** will be explained. FIG. **11** shows an initial state of an inkjet type recording apparatus in which initial filling of ink from ink cartridges to a recording head and other passages is performed. The initial filling is carried out after the ink cartridges are initially mounted in the inkjet type recording apparatus. The initial state corresponds to a third state in which both of the openings **421**, **422** of the communication passage **223** are maintained open, differently from the first and second states.

FIG. **12** illustrates the aforementioned first state in which the opening **421** is closed and the opening **422** is open in the communication passage **223**. FIG. **13** illustrates the aforementioned second state in which the opening **421** is open and the opening **422** is closed in the communication passage **223**. By switching between the first state and the second state, ink to be used is switched from one color to another.

First, the third state illustrated in FIG. **11** will be described. In this state, the sliders **250** are maintained at the positions at which the sliders **250** are not pressing, or separate from, the first pressing member **241** and the second pressing member **242**. The urging member **70** of the operation device **224** urges the first operating portion **72**A toward the first diaphragm **221** against the urging force of the first urging member **243** secured to the first diaphragm **221**. The urging member **70** of the operation device **224** also urges the second operating portion **72**B toward the second diaphragm **222** against the urging force of the second urging member **244** secured to the second diaphragm **222**. As a result, the opening **421** and the opening **422** of the communication passage **223** become open.

When the ink cartridges **11**D, **11**E are installed in this state, the recording head **20** communicates with both of the ink cartridges **11**D, **11**E. At this stage, initial filling of ink to, for example, the recording head **20** and the passages in the pressure adjustment portions **43**D, **43**E is performed for initial use of the inkjet type recording apparatus **10** after installment of the ink cartridges **11**D, **11**E. Specifically, the nozzle plate

surface **21**A of the recording head **20** is capped by the cap member **8** and negative pressure is applied to the nozzle openings **52** by the suction pump **9**. This introduces unused ink from the ink cartridges **11**D, **11**E into the recording head **20**.

In such initial filling, the opening **421** and the opening **422** of the communication passage **223** are both open and the passages to the communication passage **223** are maintained open at the first and second diaphragms **221**, **222**. By applying negative pressure to the nozzle openings **52** with the ink cartridges **11**D, **11**E communicating with the recording head **20**, the ink is supplied from the ink cartridges **11**D, **11**E to, for example, the passages in the recording head **20** and the pressure adjustment portions **43**D, **43**E. At this stage, the passage to the diaphragm chamber **221**B and the passage to the diaphragm chamber **222**B are filled solely with the ink of the corresponding ink cartridges **11**D, **11**E. However, the two colors of ink from the ink cartridges **11**D, **11**E are mixed, or maintained in a mixed color state, in the communication passage **223** and the recording head **20**.

Therefore, after the initial filling is completed with the opening **421** and the opening **422** of the communication passage **223** maintained open, the opening facing the diaphragm corresponding to the ink cartridge retaining the ink that is not to be used afterward is closed. That is, solely the opening facing the diaphragm corresponding to the ink cartridge retaining the ink that is to be used afterward is maintained open. Suction is then performed to draw and discharge the ink in the mixed color state from the communication passage **223** and the recording head **20**. Subsequently, the communication passage **223** and the recording head **20** are filled with the ink that is to be used afterward from the ink cartridge. At this stage, the inkjet type recording apparatus **10** becomes ready to use. When suction is repeated after the suction involved in the first filling, the amount and/or the time of suction become smaller than those in the initial filling.

Switching between the first state and the second state will hereafter be explained. Referring to FIG. **6**, for example, each of the nozzle opening rows **53** of the recording head **20** includes the multiple nozzle openings **52**. The following explanation starts with a case in which the photo black ink PB of the ink cartridge **11**E is ejected from the nozzle openings **52** of the nozzle opening row **53**.

In this case, referring to FIGS. **7** and **8**A, one of the sliders **250** presses the first pressing member **241** in the first direction Z**1** and the other one of the sliders **250** is separated from the second pressing member **242** to release the second pressing member **242**. The first pressing member **241** presses the film-like portion **260** of the first diaphragm **221** in the first direction Z**1** against the urging force of the first urging member **243**. The operation device **224** is thus pressed also in the first direction Z**1**, causing the film-like portion **280** of the second diaphragm **222** to be pressed in the first direction Z**1**. This causes the film-like portion **260** of the first diaphragm **221** to reliably seal the opening **421** of the communication passage **223** using the first seal portion **261**. That is, the first seal portion **261** contacts the first circumferential portion **321** of the communication passage **223**.

Contrastingly, the film-like portion **280** of the second diaphragm **222** is pressed in the first direction Z**1**, separating the second seal portion **281** from the second circumferential portion **322**. This maintains the opening **422** of the communication passage **223** in an open state. The direction indicated by arrow A in FIGS. **7** and **8**A represents the ink flow direction of this state. In this manner, the photo black ink PB flows from the ink cartridge **11**E to the communication passage **223** of the body **210** via the pressure adjustment portion **43**E, the second passage portion **212** of the body **210**, and the ink inlet hole **291**. The photo black ink PB is then sent through the communication passage **223** and the lines **230**, **231** and ejected from the nozzle opening **52** of the nozzle opening row **53** shown in FIG. **6** through the needle member **61**.

The photo black ink PB is switched to the matte black ink MB in the following manner. Specifically, the sliders **250** are caused to slide in the sliding direction SD by manipulating the levers **450**. The levers **450** press the second pressing member **242** in the second direction Z**2** against the urging force of the second urging member **244** and release the first pressing member **241**. Therefore, in the second state shown in FIG. **13**, contrastingly to the first state shown in FIG. **7**, the second seal portion **281** of the second diaphragm **222** contacts the second circumferential portion **322** of the communication passage **223**. The film-like portion **280** thus seals the opening **422** of the communication passage **223**. Contrastingly, the first seal portion **261** of the first diaphragm **221** is separated from the first circumferential portion **321** of the communication passage **223**. The opening **421** of the communication passage **223** thus becomes open. The direction indicated by arrow B in FIG. **13** represents the ink flow direction of this state.

That is, the open/closed states of the opening **421** and the opening **422** of the communication passage **223** are maintained in states opposite to those of the first state. In this state, the matte black ink MB flows from the ink cartridge **11**D to the communication passage **223** through the pressure adjustment portion **43**D, the first passage portion **211** of the body **210**, and the ink inlet hole **271**. The matte black ink MB is then sent to the communication passage **223** and the lines **230**, **231** and ejected from the nozzle opening **52** of the corresponding nozzle opening row **53** of the recording head **20** through the needle member **61**.

Also in a case in which the matte black ink MB is switched to the photo black ink PB, the open/closed states of the first diaphragm **221** and the second diaphragm **222** are changed to switch the ink passages from one type of ink to another.

The illustrated embodiment has the following advantages.

In the illustrated embodiment, the switching device **200** is mounted in the portion close to the recording head **20**, or, preferably, in the carriage **5**. The switching device **200** switches from one ink passage to another. In other words, switching of different types of ink by switching from one ink passage to another is brought about in the vicinity of the recording head **20**. Therefore, the embodiment has the following advantages.

If a switching device is arranged not at a position close to a recording head but at a position close to a plurality of ink cartridges and, for example, matte black ink is switched to photo black ink, the matte black ink remains in a long tube extending from the switching device to the recording head. The matte black ink thus must be discharged from the tube through forcible suction. That is, without such ink drainage, the matte black ink and the ink that is to be used afterward will be mixed. The forcible suction thus consumes the ink unnecessarily.

However, in the illustrated embodiment, since the switching device **200** is located close to the recording head **20**, the amount of the ink drained in this manner decreases, thus reducing the consumption amount of the ink. Further, using the switching device **200**, types of ink ejected from the nozzle openings **52** of the common nozzle opening row **53** can be reliably and easily switched from one type to another.

In the inkjet type recording apparatus **10** of the illustrated embodiment, types of ink flowing to the recording head **20** through the communication passage **223** can be switched from one type to another through movement of the first dia-

phragm **221** and the second diaphragm **222**. Using the first diaphragm **221** and the second diaphragm **222**, supply of different types of ink can be reliably stopped or brought about. Since supply of ink is permitted and prohibited by the diaphragms, leakage is prevented. The operation device **224** is capable of reliably and mechanically transmitting opening and closing operation of the first diaphragm **221** to the second diaphragm **222** as the opening and closing operation of the second diaphragm **222**. The operation device **224** is received in the communication passage **223**, which functions also as the ink passage. That is, since the first and second diaphragms **221**, **222**, or valve members, are received using the passage, the valve mechanism as a whole becomes compact.

One of the two openings **421**, **422** of the communication passage **223** may be open when the other is closed. Further, the openings **421**, **422** may become open at the same time. Therefore, for example, when initial filling is performed after the ink cartridges are first installed, both of the openings **421**, **422** are opened to complete the initial filling for all of the ink cartridges by a single cycle of initial filling. In this case, unlike a conventional case, the initial filling does not have to be disadvantageously repeated for two cycles. Further, the two diaphragms **221**, **222** face each other and the communication passage **223** between the diaphragms **221**, **222** communicates with the recording head **20**. This permits arrangement of the diaphragms **221**, **222** close to each other and decreases the size of the space in the communication passage **223** in which different types of ink flows. The time spent for switching inks is thus shortened and the amount of the ink consumed for switching is decreased. Also, since the space in the communication passage **223** is reduced in size, there is little space left for retaining bubbles even if one of the ink cartridges is not used. This prevents a defect in ink ejection caused by the bubbles.

The switching device **200** has the switch operating portion **399**, which operates the operation device **224** by pressing the first diaphragm **221** or the second diaphragm **222** to switch the open/closed states of the two openings **421**, **422** of the communication passage **223**. Therefore, using the first diaphragm **221** and the second diaphragm **222**, supply of different types of liquid ink is reliably stopped or carried out. Since such supply of the ink is permitted and prohibited through the diaphragms **221**, **222**, liquid leakage is prevented.

The switching device **200** has the first urging member **243** and the second urging member **244**. Therefore, even if intense negative pressure is produced in the body **210**, the diaphragms **221**, **222** are stably held in tight contact with the circumferential portions of the communication passage **223**, maintaining a liquid-tight state.

The urging force of the urging member **70** of the operation device **224** is set to a value that is greater than the urging force of the first urging member **243** and than the urging force of the second urging member **244**. Therefore, by releasing the pressing force applied to the first diaphragm **221** and the second diaphragm **222**, the correspondingly released diaphragm is reliably opened against the urging force of the first or second urging member **243**, **244**. Opening and closing operation of the first and second diaphragms **221**, **222** is thus reliably accomplished.

The grooves **400** or the uneven portions are provided in the first circumferential portions **321** and the second circumferential portion **322**. Therefore, when the first diaphragm **221** or the second diaphragm **222** seals the corresponding circumferential portion of the communication passage **223**, the first or second diaphragm **221**, **222** is prevented from tightly contacting the circumferential portion of the communication passage **223**.

The first diaphragm **221** has the first seal portion **261** that tightly contacts the first circumferential portion **321**. The second diaphragm **222** has the second seal portion **281** that tightly contacts the second circumferential portion **322**. The film-like portion **260** and the film-like portion **280** are formed inside the first seal portion **261** and the second seal portion **281**, respectively. Therefore, even if the diaphragms **221**, **222** receives intense negative pressure and the operation device **224** is moved slightly, the diaphragms **221**, **222**, which maintain the openings **421**, **422** of the communication passage **223** in closed states, elastically deform and absorb the slight movement of the operation device **224**. This prevents the movement of the operation device **224** from influencing the liquid-tight state of the seal portions **261**, **281** of the diaphragms **221**, **222**, which maintain the openings **421**, **422** in the closed state. That is, even if force acts on the operation device **224** to move the operation device **224** greatly, the force is transmitted to the sliders **250** through the pressing members **241**, **242** that press the diaphragms **221**, **222**, suppressing movement of the operation device **224**. The diaphragms **221**, **222** thus maintain the liquid-tight state without moving greatly.

The switch operating portion **399** has the first pressing member **241**, the second pressing member **242**, and the sliders **250**. Thus, simply by moving the sliders **250**, opening and closing operation of the first diaphragm **221** and the second diaphragm **222** is carried out along the direction in which the communication passage **223** is opened or closed.

The sliding direction SD of the sliders **250** is substantially perpendicular to the first direction Z1 and the second direction Z2 of the first pressing member **241** and the second pressing member **242**. Therefore, even if intense suction force acts on the nozzles of the recording head **20** and the nozzles receive negative pressure, an open one of the openings of the communication passage **223** is maintained in the open state. Accordingly, regardless of intense vibration or intense negative pressure produced in the body **210**, the sliders **250** stably perform the opening and closing operation of the first diaphragm **221** and the second diaphragm **222**.

The switching device **200** is arranged in the vicinity of the recording head **20**. Therefore, when ink is switched from one type to another, only the ink remaining between the switching device **200** and the recording head **20** is drawn. Then, the ink is switched to a different type of ink, which is supplied to the recording head **20**. This decreases the amount of the ink drained by switching ink types, suppressing unnecessary consumption of the ink. Different types of ink are thus reliably ejected from the common nozzles.

The switching device **200** is mounted in the carriage **5**, which holds the recording head **20**. Switching of ink is thus carried out in the vicinity of the recording head **20**.

The carriage **5** has the levers **450** for moving the sliders **250** in the sliding direction SD. Sliding of the sliders **250** is thus reliably accomplished by the levers **450** in the carriage **5**.

The switching device **200** is arranged in correspondence with the nozzle opening rows **53** defined in the recording head **20**. This permits switching of ink to be used in accordance with the nozzle opening rows **53**.

In the inkjet type recording apparatus **10** of the illustrated embodiment, the operation device **224** has the urging member **70** that urges the first operation end **224**A and the second operation end **224**B, which open the communication passage **223**, toward the first diaphragm **221** and the second diaphragm **222**, respectively. In the initial filling performed after the ink cartridges are first installed, the openings **421**, **422** of

the communication passage **223** are opened to complete the initial filling of all of the ink cartridges by a single cycle of initial filling.

The initial filling is carried out through suction with the openings **421**, **422** of the communication passage **223** each maintained in an open state by the first and second diaphragms **221**, **222**, which are formed in the switching device **200**. Then, the opening of the communication passage **223** corresponding to the ink cartridge retaining the ink that is not to be used afterward is closed. That is, the opening of the communication passage **223** corresponding to the ink cartridge retaining the ink that is to be used afterward is maintained in the open state. In this state, suction is performed to draw and drain the mixed ink from the passage from the ink cartridges to the recording head **20** and the interior of the recording head **20**. The passage from the ink cartridges to the recording head **20** and the interior of the recording head **20** are then filled with the ink that is to be used afterward. The inkjet type recording apparatus **10** thus becomes ready to use.

The illustrated embodiments may be embodied in the following modified forms.

In the embodiments of the invention, switching between the matte black ink and the photo black ink is described, by way of example, as switching of different types of ink. However, the switching of the ink is not restricted to that of these embodiments but may be performed among other types of ink. For example, dye ink and pigment ink, as different types of ink, may be switched between each other, and other types of ink may be switched. Alternatively, switching is not restricted to switching between inks but may be switching between functional liquids other than ink, for example, cleansing liquid and moisturizing liquid or ink and functional liquid.

The off-carriage type inkjet type recording apparatus **10** shown in FIG. **1** has, for example, eight ink cartridges. However, the present invention is not restricted to this structure but may include two to seven or nine or more ink cartridges.

In each of the illustrated embodiments, the recording head **20** may be applied to a type of liquid ejection apparatus using a piezoelectric vibrator as a pressure generating element, which is a drive element that operates to eject liquid, or a type of liquid ejection apparatus using a heat generating element.

A program that executes a switching procedure and an initial filling method performed in the liquid ejection apparatus as has been described may be provided as data recorded in a recording medium or through a communication network.

A typical example of a liquid ejection apparatus is the inkjet type recording apparatus **10** including the above-described inkjet type recording head for recording images. However, the present invention may be applied to different types of liquid ejection apparatuses, such as an apparatus having a color material ejection head used in the manufacture of color filters of liquid crystal displays, an apparatus having an electrode material (conductive paste) ejection head used in the manufacture of electrodes of organic EL displays or surface emitting displays (FEDs), an apparatus having a bioorganic substance ejection head used in the manufacture of biochips, or an apparatus including a sample ejection head as a precision pipette, as other types of liquid ejection apparatuses.

The present invention is not limited to the illustrated embodiments but may be modified in various forms without departing from the scope of the claims. A part of each configuration of the illustrated embodiments may be omitted or the configurations may be combined as needed in a manner different from the above-described manners. Although the multiple embodiments have been described herein, it will be clear to those skilled in the art that the present invention may be embodied in different specific forms without departing from the spirit of the invention. The invention is not to be limited to the details given herein, but may be modified within the scope and equivalence of the appended claims.

The invention claimed is:

1. A liquid ejection apparatus comprising:

an ejection head including a nozzle in which liquid is ejected through the nozzle;

a plurality of cartridges that retain the liquid and supply liquid to the ejection head; and

a switching mechanism that switches liquid to be supplied to the ejection head from a plurality of types of liquids supplied from the cartridges, the switching mechanism including:

a body having a communication passage in communication with the ejection head;

a first diaphragm chamber and a second diaphragm chamber that communicate with each other through the communication passage and located facing each other;

a first diaphragm and a second diaphragm arranged in the first diaphragm chamber and the second diaphragm chamber, respectively, the first diaphragm and the second diaphragm each being capable of opening and closing the communication passage; and

an operation mechanism provided in the communication passage, the operation mechanism including:

a first operation end and a second operation end that operate the first diaphragm and the second diaphragm, respectively, when the communication passage is opened to allow communication between the ejection head and at least one of the first and second diaphragm chambers; and

an urging member that urges the first and second operation ends in a direction in which the communication passage is opened by the first and second diaphragms,

wherein the switching mechanism has a switch operating portion that switches an open/closed state of the communication passage by pressing the first diaphragm or the second diaphragm to operate the operation mechanism,

wherein when the switching operating portion does not press the first diaphragm and the second diaphragm, the first and second chambers communicate with the ejection head,

wherein the body includes:

a first circumferential portion arranged around one of a pair of openings of the communication passage and facing the first diaphragm; and

a second circumferential portion arranged around the other opening of the communication passage and facing the second diaphragm,

wherein the switching mechanism includes:

a first urging member that presses the first diaphragm against the first circumferential portion to seal the communication passage; and

a second urging member that presses the second diaphragm against the second circumferential portion to seal the communication passage, and

wherein urging force of the urging member of the operation mechanism is set to a value greater than urging force of the first urging member of the switching mechanism and also greater than urging force of the second urging member of the switching mechanism.

2. The liquid ejection apparatus according to claim **1**, wherein the first circumferential portion and the second cir-

cumferential portion each have a groove or an uneven portion facing the first diaphragm or the second diaphragm.

3. The liquid ejection apparatus according to claim **2**, wherein the first circumferential portion and the second circumferential portion each have a groove facing the first diaphragm or the second diaphragm.

4. The liquid ejection apparatus according to claim **1**, wherein the first diaphragm includes:

a first seal portion held in tight contact with the first circumferential portion and having an annular shape; and

a film-like portion formed inside the first seal portion, and the second diaphragm includes:

a second seal portion held in tight contact with the second circumferential portion and having an annular shape; and

a film-like portion formed inside the second seal portion.

5. The liquid ejection apparatus according to claim **1**, wherein the switch operating portion includes:

a first pressing member that presses the first diaphragm against one of a pair of openings of the communication passage to seal the communication passage;

a second pressing member that presses the second diaphragm against the other opening of the communication passage to seal the communication passage; and

a slider that moves in a sliding direction passing through a position at which the slider contacts the first pressing member or the second pressing member and a position at which the slider separates from the first pressing member and the second pressing member, whereby moving the first pressing member or the second pressing member in a first direction or in a second direction, the first direction extending along the direction in which the communication passage is opened by the first diaphragm or the second diaphragm, the second direction extending along the direction in which the communication passage is opened and in a direction opposite to the first direction.

6. The liquid ejection apparatus according to claim **5**, wherein the sliding direction of the slider is substantially perpendicular to the first direction and the second direction of the first pressing member and the second pressing member.

7. The liquid ejection apparatus according to claim **5**, further comprising:

a carriage in which the ejection head is arranged; and

a lever provided in the carriage for sliding the slider.

8. The liquid ejection apparatus according to claim **1**, wherein the switching mechanism is arranged in the vicinity of the ejection head.

9. The liquid ejection apparatus according to claim **1**, further comprising a carriage in which the ejection head is provided, wherein the switching mechanism is arranged in the carriage.

10. The liquid ejection apparatus according to claim **1**, wherein the ejection head has a nozzle row including the nozzles, and

wherein the switching mechanism is provided in correspondence with the nozzle row.

11. A liquid ejection apparatus comprising:

an ejection head including a nozzle in which liquid is ejected through the nozzle;

a plurality of cartridges that retain the liquid and supply liquid to the ejection head; and

a switching mechanism that switches liquid to be supplied to the ejection head from a plurality of types of liquids supplied from the cartridges, the switching mechanism including:

a body having a communication passage in communication with the ejection head;

a first diaphragm chamber and a second diaphragm chamber that communicate with each other through the communication passage and located facing each other;

a first diaphragm and a second diaphragm arranged in the first diaphragm chamber and the second diaphragm chamber, respectively, the first diaphragm and the second diaphragm each being capable of opening and closing the communication passage; and

an operation mechanism provided in the communication passage, the operation mechanism including:

a first operation end and a second operation end that operate the first diaphragm and the second diaphragm, respectively, when the communication passage is opened to allow communication between the ejection head and at least one of the first and second diaphragm chambers; and

an urging member that urges the first and second operation ends in a direction in which the communication passage is opened by the first and second diaphragms,

wherein the body includes:

a first circumferential portion arranged around one of a pair of openings of the communication passage and facing the first diaphragm; and

a second circumferential portion arranged around the other opening of the communication passage and facing the second diaphragm, and

the switching mechanism includes:

a first urging member that presses the first diaphragm against the first circumferential portion to seal the communication passage; and

a second urging member that presses the second diaphragm against the second circumferential portion to seal the communication passage, and

wherein urging force of the urging member of the operation mechanism is set to a value greater than urging force of the first urging member of the switching mechanism and also greater than urging force of the second urging member of the switching mechanism.

12. The liquid ejection apparatus according to claim **11**, wherein the first circumferential portion and the second circumferential portion each have a groove or an uneven portion facing the first diaphragm or the second diaphragm.

13. The liquid ejection apparatus according to claim **11**, wherein the first diaphragm includes:

a first seal portion held in tight contact with the first circumferential portion and having an annular shape; and

a film-like portion formed inside the first seal portion, and the second diaphragm includes:

a second seal portion held in tight contact with the second circumferential portion and having an annular shape; and

a film-like portion formed inside the second seal portion.

14. A liquid ejection apparatus comprising:

an ejection head including a nozzle in which liquid is ejected through the nozzle;

a plurality of cartridges that retain the liquid and supply liquid to the ejection head; and

a switching mechanism that switches liquid to be supplied to the ejection head from a plurality of types of liquids supplied from the cartridges, the switching mechanism including:

a body having a communication passage in communication with the ejection head;

a first diaphragm chamber having a first diaphragm and a second diaphragm chamber having a second diaphragm, wherein the first and second diaphragm chambers communicate with the communication passage and are located facing each other; and

a first pressing member and a second pressing member selectively located between a state in which one of the

first and second pressing members presses corresponding one of the first and second diaphragms to communicate the communication passage with the corresponding one of the first and second diagram chambers and a state in which the first and second pressing members do not press the first and second diaphragms to communicate the communication passage with the first and second diaphragm chambers.

15. The liquid ejection apparatus according to claim **14**, wherein the apparatus includes:

a first state in which the first pressing member presses the first diaphragm so that the second diaphragm chamber communicates with the ejection head;

a second state in which the second pressing member presses the second diaphragm so that the first diaphragm chamber communicates with the ejection head; and

a third state in which the first pressing member and second pressing members do not press the first diaphragm and the second diaphragm, respectively, and the first diaphragm chamber and the second diaphragm chamber communicate with the ejection head.

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